DISCRETE POWER LEVEL CODING FOR INDICATING UPLINK MOBILE RECEIVE

LEVEL IN A WIRELESS REPEATER SYSTEM

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5 **CROSS REFERENCE TO RELATED APPLICATIONS**

This application is related to and claims priority to U.S. Provisional

Application 60/173,541 entitled "Discrete Backhaul Power Transmission From a

Translating Repeater to Indicate Uplink Mobile Receive Level" filed December 29th,

10 1999, the entirety of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

15 **Field of the Invention**

The instant invention pertains generally to the field of wireless cellular

communication. More particularly, the invention describes a method and apparatus

for automatically controlling power level in a backhaul channel of a wireless cellular

20 repeater system.

Description of Related Art

25 In wireless cellular communication systems, it is desirable for a base

transceiver station (BTS) to have an indication of the received mobile unit power

levels on all the channels in the system at all times. Such information permits the

BTS to effectively manage the mobile transceiver units, repeater stations and the

home base stations, including actions such as handoff. In repeater based wireless

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cellular communications systems, any power level measurements for the channels in the system are at best mere approximations.

The reason for such approximations is that in wireless cellular communication systems having repeaters, the signal from the mobile stations is

5   first received by the repeater station. These repeater stations typically have automatic level control (ALC) circuitry that may attenuate or boost the received signal power level to ensure that the signal transmitted by the repeater is received by the serving home base station at a sufficient power level. The ALC alters the characteristics of the received signal including important information such as the

10   received power level. For example, the ALC may cause the power level of the backhaul signal transmitted from the repeater to the base station to be a non-linear function relative to the power received from the mobile units. More specifically, power received from a mobile unit at the repeater station in the range from -25 dBm to -65 dBm would be re-transmitted at -62 dBm in an existing system. In

15   other instances, the ALC may cause the power level of the backhaul signal transmitted from the repeater station to the base station to be compressed in certain power ranges into a ratio of 2:1 for example. More specifically, power received from a mobile unit at the repeater station in the range from -65 to -105 dBm would be re-transmitted at -62 to -82 dBm in an existing system. Under this

20   scenario, a repeater station is difficult to calibrate, test and install.

One of the consequences of automatic level control is that the power level of the signal that is transmitted from the mobile transceiver station to the repeater station is not necessarily correlated to the signal level that is transmitted from the repeater station to the serving home base station. This is because the home base station only receives signal power level information pertaining to the signal that is modified by the ALC in the repeater station. As a result, any indication of the signal power level that the home base station sends to the managing base station controller will not necessarily be an accurate representation of the actual signal power level of the mobile transceiver station or pilot signal from an unused channel. Even if a linear correlation is established between the power level received at the repeater and the corresponding power level received at the base transceiver station, this would still require strict installation procedures and precise backhaul signal configurations to ensure proper power control and handoff functions. There is not much margin for error or tolerance given in such installations. Accordingly, there has been a need to provide a more effective solution to the problem of controlling a wireless cellular communication system having one or more repeaters that would allow for less stringent installation procedures and less performance variations due to radio frequency component characteristics.

SUMMARY OF THE INVENTION

In a first aspect of the present invention, a method for managing a plurality

of mobile transceiver units in a wireless cellular communication system having a

base transceiver station located within a home cell and a plurality of substantially

5   adjacent cells each having a repeater located therein comprises the steps of

receiving at one of said repeaters, a signal from a mobile transceiver unit on an

uplink communication channel, measuring at said repeater a power level of said

signal as received by said repeater, and transmitting a backhaul signal from said

repeater to said base transceiver station on a backhaul communication link, wherein

10   said backhaul signal is transmitted at one of a plurality of discrete power levels

providing an indication of said power level as measured by said repeater.

In another aspect of the present invention, a repeater in a wireless cellular

communication system comprises a receiver for receiving a signal from a mobile

transceiver unit via an uplink communication channel, power measurement means

15   for measuring a power level of said signal as received by said repeater, and a

transmitter for transmitting a backhaul signal from the repeater to the base

transceiver station via a backhaul communication link. Preferably, the backhaul

signal is transmitted at one of a plurality of discrete power levels providing an

indication of the power level from the mobile transceiver as measured by said

20   repeater

In yet another aspect of the present invention, a configurable base transceiver station in a communication system having the base transceiver station located within a home cell and a plurality of substantially adjacent cells each having a repeater located therein comprises a transmitter for transmitting traffic and

5 control signals to the repeater, a receiver for receiving a backhaul signal from the repeater, and a processor that is programmed to selectively configure the plurality of discrete power levels at which the repeater will transmit the backhaul signal. The backhaul signal is transmitted at one of a plurality of discrete power levels indicative of a power level measured from an uplink communication channel at the

10 repeater.

BRIEF DESCRIPTION OF THE DRAWINGS

There are shown in the drawings embodiments which are presently

5   preferred, it being understood, however, that the invention is not limited to the

precise arrangements and instrumentalities shown, wherein:

FIG. 1 is a block diagram of a wireless communications system employing

wireless translator/repeater stations in accordance with the present invention.

FIG. 2 is a block diagram of an exemplary translator repeater station of the

10   type shown in the wireless communication system of FIG. 1.

FIG. 3 is a block diagram of an exemplary base transceiver station of the

type shown in the wireless communication system of FIG. 1.

FIG. 4 is a flow chart illustrating a method of managing a plurality of mobile

transceiver units in accordance with the present invention.

15   FIG. 5 is a flow chart illustrating a method of controlling a power level in a

backhaul communications link in accordance with the present invention.

FIG. 6 is a chart illustrating an exemplary measured input power level

received at a repeater and a corresponding predetermined output power level

received at a base transceiver station in accordance with the present invention.

20   FIG. 7 is another chart illustrating an exemplary measured input power level

received at a repeater and a corresponding predetermined output power level

received at a base transceiver station along with respective instructions to the

mobile transceiver unit in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a block diagram of a wireless communications system such as a

Personal Communication System ("PCS") or other similar system in accordance. In

5   this system, single-omni type wireless translators/repeaters are deployed in

peripheral cells of a cell cluster to concentrate radio signal traffic to and from a

broadband base transceiver station ("BTS"). Those skilled in the art will readily

appreciate that sectorized wireless translators can also be used for this purpose.

However, for convenience, the system will first be described relative to the single-

10   omni type translator/repeater system.

The system 10 can include translator omni-directional antennas 11-1, 11-2, .

. . 11-i, . . . 11-n-2, 11-n-1 and 11-n (collectively omni-directional antennas 11),

translator base stations 12-1, 12-2, . . . 12-i, . . . 12-n-2, 12-n-1 and 12-n

(collectively repeaters 12), translator directional antennas 13-1, 13-2, . . . 13-i, . . .

15   13-n-2, 13-n-1 and 13-n (collectively repeater directional antennas 13), BTS

directional antennas 14-1, . . . 14-m (collectively BTS antennas 14), and broadband

base transceiver stations 15-1, . . . 15-m (collectively BTSs 15). System 10 can

further include mobile telephone exchange 16, one or more base station controllers

17 and a plurality of mobile subscriber units 18-1 and 18-2 (collectively mobile

20   units 18).

Repeaters 12 conventionally receive radio signals from mobile units 18 through omni-directional antennas 11 and forward them to BTS's 15 through repeater directional antennas 13. Likewise, radio signals transmitted from BTS's 15 through BTS antennas 14 are forwarded by repeater12 to mobile units 18.

5   BTS's 15 are responsible for demodulating signals received from repeaters 12 through BTS antennas 14 and connecting these signals to the Public Switched Telephone Network (PSTN) through mobile telephone exchange 16. In addition, BTS's 15 modulate signals received from the PSTN through mobile switching center 16 to format them for transmission through BTS antennas 14 to repeaters

10   12.

Operationally, repeater 12 transmits signals to and receives signals from BTS 15 through backhaul channel 19. Similarly, repeater 12 transmits signals to and receives signals from mobile unit 18 through ground link channel 20. Each of the ground link channel 20 and the backhaul channel 19 is defined by an uplink carrier

15   frequency and a downlink carrier frequency. Because BTS 15 is stationary, repeater 12 preferably employs directional antenna 13 to transmit and receive signals over backhaul channel 19. In contrast, because mobile units 18 are not stationary and the repeater is not sectorized, repeater 12 preferably employs one or more omni-directional antennas 11 to transmit and receive signals over ground link

20   channel 20.

Communications between mobile units 18, repeaters 12, and BTS 15 can be performed using a variety of multiplexing schemes that are well known in the art. For example, a time division multiplex (TDM) scheme may be used for this purpose.

Fig. 2 is a detailed block diagram block of a repeater 12 that can be used in

5 connection with the present invention. The repeater 12 can comprise a ground sector transceiver 27 and backhaul transceiver 28. It will readily be appreciated by those skilled in the art that other types of transceiver architectures may be used to practice the invention and the particular transceiver architecture as described herein is not intended be a limitation on the invention.

10 In a preferred embodiment, transceivers 27 and 28 are each capable of transmitting and receiving over a broad range of carrier frequencies allocated to a service provider for multi-carrier operation. However, the invention is not limited in this regard and more narrowbanded transceivers can also be used for the purposes of the present invention. Each transceiver 27, 28 is preferably configured so that

15 its operation can be controlled by microprocessors 46 and 47, respectively.

FIG.2 shows a single sector omni-type wireless repeater system, it being understood that the invention is not so limited. In fact, a variety of sectorized translation repeaters can also be used for this purpose. Signals from a mobile unit 18 are received at omni-directional antennas 11A and/or 11B attached to ground

20 sector transceiver 27. These signals are encoded and transmitted by mobile unit 18 using a standard wireless telephony format such as GSM and typically range in

power from between about -111 to -25 dBm. The signal passes through cavity

filter 29A on to downconverter 35A or, alternatively, 35B where, in conjunction

with synthesizer module 36A and voltage-controlled crystal oscillator 37A, the

signal is mixed down to intermediate frequency or IF. A high-speed analog-to-

5   digital converter 39A (or 39B) then converts the analog IF signal into a digital

signal. Once the IF signal is digitized, digital downconverter 41A (or 41B)

translates the signal down to complex baseband. Digital downconverter 41

preferably provides the ability to downconvert, decimate, filter and control the gain

of the signal. After being converted to complex baseband, the signal is

10   demodulated by digital signal processor 42A. Digital signal processor 42A is

configured for decoding the received signal data from the standard wireless

telephony format, such as GSM, to a common format used internally within the

translator.

The common format data is then transferred to digital signal processor 42B

15   in the backhaul transceiver 28 over multi-channel buffered serial port 32.

Subsequently, the signal is re-modulated by digital signal processor 42B. The re-

modulated signal is output as a complex baseband signal and translated to real IF

by digital upconverter 40B. After the signal is translated to real IF, digital-to-analog

converter 38C converts the signal back to an analog signal where it is mixed by

20   upconverter 34B in conjunction with synthesizer module 36B and voltage-controlled

crystal oscillator 37B. Now ready to be broadcast, the signal passes through

cavity filter 29B and is transmitted through the backhaul channel to the BTS 15

through repeater directional antenna 13.

The transceivers 27 and 28 are preferably controlled by one or more control

circuits. The control circuits can be in the form of a general purpose computer

5   interfaced with the transceiver, a programmable microprocessor integrated with the

transceivers with appropriate software, a hardware based controller, or any other

combination of microprocessors, electronic circuitry and programming as may be

necessary or appropriate for controlling the first and second transceivers.

As shown in Fig. 2, the control circuits include master processor 47 and

10   control processor 46. Master processor 47 preferably controls the operation of

backhaul transceiver 28, including selection of transmit and receive frequencies.

Master processor 47 is also linked with PCM data and message bus 31 so that it

can communicate with control processor 46, and vice versa. Control processor 46

is preferably a slave processor controlled by master processor 47. Control

15   processor 46 can also preferably control the operation of ground sector transceiver

27, including selection of transceiver receive and transmit frequencies.

Translation of the signals transmitted from the BTS 15 through the backhaul

channel is similar to the procedure employed to translate signals transmitted from

the mobile units 18. Specifically, a signal, preferably at -70 dBm but typically

20   ranging anywhere from -111 dBm to -25 dBm, is received from a BTS 15 at

repeater directional antenna 13 attached to backhaul transceiver 28. The signal

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passes through cavity filter 29B to down converter 35C where, in conjunction with synthesizer module 36B and voltage-controlled crystal oscillator 37B, the signal is mixed down to IF. Analog-to-digital converter 39C converts the analog IF signal to a digital signal where it is subsequently processed by digital downconverter 41C to

5   complex baseband. The receive channel consisting of downconverters 35D, A/D 39D and DDC 41D are not necessarily used in this embodiment of the invention.

Once converted into complex baseband, the signal is demodulated by digital signal processor 42B and transferred to digital signal processor 42A over multi-channel buffered serial port 32. The signal is then re-modulated by digital signal

10   processor 42A and translated from complex baseband to real IF by digital upconverter 40A. After the signal is translated to real IF, digital-to-analog converter 38A converts the signal back to an analog signal. Upconverter 34A, synthesizer 36A, and voltage-controlled crystal oscillator 37A operate together to mix the signal for transmission. The signal is then amplified by high-power

15   amplifier 30, filtered by cavity filter 29A and transmitted from omni-directional antenna 11A to the mobile unit 18 through the ground link channel 20.

Referring now to FIG. 3, a broadband BTS 15 is illustrated, which comprises a receiver section 56 and a transmitter section 55. It will be readily appreciated by those skilled in the art that the particular transceiver architecture shown is not

20   critical. Accordingly, the invention disclosed herein is not intended to be so limited.

Receiver section 56 preferably includes antennas 68, 70 and a wideband receiver

51 capable of receiving a plurality of carrier frequency channels. Signals from the received channels can include new power requests, power adjustment requests and traffic channel data from mobile transceiver units. The term "wideband" as used herein, is not limited to any particular spectral range, and it should be understood

5   to imply a spectral coverage of multiple frequency channels within the communication range over which a wireless communication system may operate (e.g. 60 MHZ). Narrowband, on the other hand, implies a much smaller portion of the spectrum, for example, the width of an individual channel (e.g. 200 kHz).

        The output of the wideband receiver 51 is down-converted into a multi-

10   channel baseband signal that preferably contains the contents of all of the voice/data carrier frequency channels currently operative in the communication system or network of interest. This multichannel baseband signal is preferably coupled to high speed A-D converters 52-1 and 52-2 operating in parallel for diversity receive capability. Where no diversity capability is required, a single A-D

15   52-1 could be utilized. Additionally, more than one parallel leg may be required for sectorized applications. Hence, it should readily be appreciated by one skilled in the art that the presence of a second parallel processing leg is not intended to be a limitation on the instant invention. The dynamic range and sampling rate capabilities of the A-D converter are sufficiently high (e.g. the sampling rate may be

20   on the order of 25 Mega-samples per second (Msps)) to enable downstream digital signal processing (DSP) components, including Discrete Fourier Transform (DFT)

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channelizers 53-1 and 53-2, to process and output each of the active channels

received by receiver 56.

The channelized outputs from the A-D converters are further processed to

extract the individual channel components for each of the parallel streams. FFT

5   channelizers 53-1 and 53-2 extract from the composite digitized multichannel

signals, respective narrowband carrier frequency channel signals. These

narrowband signals are representative of the contents of each of the respective

individual carrier frequency communication channels received by the wideband

receiver 51. The respective carrier frequency channel signals are coupled via N

10   output links through a common data bus 61 to respective digital signal processing

receiver units 63-1 & 63-2N, each of which demodulates the received signal and

performs any associated error correction processing embedded in the modulated

signal. In the case where the received signals are destined for the PSTN, these

demodulated signals derived from the digital signal processing receiver units 63 can

15   be sent via a common shared bus 54 to a telephony carrier interface, for example,

T1 carrier digital interface 62, of an attendant telephony network (not shown).

The transmitter section 55 includes a second plurality of digital signal

processing units, specifically, transmitter digital signal processing units 69-1 . . .

69-N, that are coupled to receive from the telephony network respective ones of a

20   plurality of channels containing digital voice/data communication signals to be

transmitted over respectively different individual carrier frequency channels of the

multichannel network. Transmitter digital signal processing units 69 modulate and

perform pre-transmission error correction processing on respective ones of the

plurality of incoming communication signals, and supply processed carrier

frequency channel signals over the common bus 54 to respective input ports of an

5   inverse FFT-based multichannel combiner unit 58. The combiner 58 outputs a

composite multichannel digital signal. This composite signal is representative of

the contents of a wideband signal that contains the respective narrowband carrier

frequency channel signals output from the digital signal processing transmitter units

69. A composite signal generated from the output of the multichannel combiner

10   unit 58 is then processed by the digital-to-analog (D-A) converter 59. The output

of D-A converter 59 is coupled to a wideband (multichannel) transmitter unit 57,

which can include or have a separate multi-channel high power amplifier (HPA)

57A. The transmitter unit 57 transmits a wideband (multichannel) communication

channel signal defined by the composite signal output of the inverse fast Fourier

15   transform-based combiner unit 58. The output of the HPA 57A is then coupled to

antenna 68 for transmission.

A central processing unit (CPU) controller 64 is provided for coordinating and

controlling the operation of BTS 15. For example, the CPU 64 can include a

control processing unit, memory and suitable programming for responding to

20   transmit power control requests received from mobile transceiver units. CPU 64

can selectively control transmit power levels of each TDM communication channels

on a timeslot-by-timeslot basis. The CPU 64 may be a microprocessor, DSP

processor, or micro controller having firmware, software or any combination

thereof.

DSPs 63 can extract information from each of the narrowband carrier

5   frequency channel signals. Information for each of these channels can be stored in

shared memory 75 through the common control and data bus 61. CPU 64, under

firmware and/or software control, can then access the shared memory 75 through

bus 61.

The BTS 15 is ideally a configurable base transceiver station having a

10   transmitter for transmitting traffic and control signals to the repeater 12 and a

receiver for receiving a backhaul signal from the repeater 12. As previously

described, the backhaul signal is transmitted at one of a plurality of discrete power

levels indicative of a power level measured from an uplink communication channel

(from a mobile transceiver unit, for example) at the repeater. The BTS 15 may also

15   comprise a processor (64) that is programmed to selectively configure the plurality

of discrete power levels at which the repeater will transmit the backhaul signal.

The processor may be further programmed to use the control signals or the traffic

signals or both to control the power level of the mobile unit 18 based consistent

with the plurality of discrete power levels measured on the backhaul signal at the

20   receiver of the base transceiver station. The processor may also be programmed

(see FIG. 7) to decrease the power level of the uplink channel if the backhaul signal

is transmitting at a first power level (such as -70 dBm), maintain the power level of

the uplink channel if the backhaul signal is transmitting at a second power level

(such as -80 dBm), increase the power level if the backhaul signal is transmitting at

a third power level (such as -90 dBm), and request that the uplink channel handoff

5   to another repeater 12 or BTS 15 if the backhaul signal is transmitting at a fourth

power level (such as -100 dBm). Using only 4 discrete uplink levels on a time slot

by time slot basis rather than a continuum of power levels simplifies installation

and calibration of such repeater stations.

Operationally, the BTS 15 measures the uplink channel from the repeater 12

10   and after programmable averaging, determines whether to change a mobile unit's

18 power or whether to handover the mobile 18 by comparing the average

received power from a mobile 18 to a set of thresholds that are either downloaded

from a base station controller 17 (see FIG. 1) or stored locally at the BTS.

Preferably, these threshold settings will conveniently fit between the different

15   predetermined power levels of the backhaul signals. For example, the upper level

threshold setting for power control decrease based on the uplink receive level could

be set at −75 dBm while the lower level threshold setting for power control

increase based on the uplink receive level could be set at −85 dBm. The lower

level threshold for a handover request based on the uplink receive level can be set

20   at −95 dBm. These three threshold settings respectfully fit between the first

through fourth power levels of −70, -80, -90, and −100 dBm as measure at the

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BTS 15 receiver. This example provides robust margins of 10 dBm for accurate

and simplified installations of repeaters 12.

FIG. 4 is a flowchart illustrating a method for automatically controlling power

levels in a backhaul channel of a wireless communication repeater system. In step

5   610, a signal from a mobile unit 18, is transmitted on an uplink channel 20. This

signal is then received at a serving repeater 12, as shown in step 620.

The power level of the signal received from the mobile unit 18 is measured

at the repeater 12 as shown in step 630. The repeater 12 adjusts its transmitter

power output on the backhaul channel in discrete steps which correlate to certain

10   predetermined ranges of input signals. This process is performed on a time-slot by

time-slot basis as the received signal is re-transmitted to the BTS 15 on backhaul

communication link 19. The method can optionally include the step 635 of

delaying the signal containing the amplitude information for a predetermined

amount of time. For example, in a Time Division Multiple Access (TDMA)

15   communication system, the repeater station 12 would preferably delay the

amplitude information for one frame so that a burst can be sent back to the BTS

from the repeater station at precisely one power level.

In step 640, this signal from the backhaul communication link 19 is then

received at a serving home base station, for example, BTS 15. The home BTS 15,

20   on receipt of the backhaul signal, can measure the received power level and

determine a corresponding range of possible input signal levels received by the

repeater 12 from the mobile units 18. In one alternative embodiment, the BTS 15

can use this indication of the received power level to more efficiently manage the

mobile units 18 and to better allocate channels within the system as shown in step

645. Alternatively, selected information concerning the mobile unit signal strength

5   can be provided to a managing base station controller 17 as shown in step 650.

The managing base station controller 17 can then use this indication of the

received power level to more efficiently manage the mobile units 18 and to better

allocate channels within the system. This is illustrated in step 660. It should be

understood, that the signal received at the home BTS 15 at step 640 does not

10   necessarily need to be decoded or demodulated for purposes of the present

invention. Again, the BTS 15 can merely measure the received power level and

determine a corresponding range of possible input signal levels received by the

repeater 12 from the mobile units.

It should also be understood that step 630 can be performed in any suitable

15   manner using hardware, software or a combination thereof which permits the

repeater to select discrete output power levels for the backhaul channel which

correspond to a selected range of power levels received from the mobile units 18.

In accordance with the invention and with reference to the exemplary

repeater 12, as illustrated in Fig. 2, step 630 is now described in detail. With

20   reference to FIG. 4, the flowchart illustrates a method for selectively controlling the

output power level on a backhaul communication link 19. The power level of the

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signal received from a mobile unit 18 is measured by control processor 46 through

the use of algorithms that are well known in the art. Control processor 46 can

convert the result of the algorithm to a digital representation as shown in step

631B of method 700 shown in FIG. 5.

5   Under the control of processor 46, the repeater 12 can maintain a lookup

table corresponding to a range of possible values that can be returned from the

measurement algorithm along with a corresponding output power level that is

required to control the transmitter for the backhaul communication link 19 for each

of the ranges. The lookup table may be stored in non-volatile memory for

10   permanent storage. Alternatively, the lookup table may be stored in non-volatile

memory, such as static RAM, where the corresponding output power level for

transmission on the backhaul communication link can be continuously updated

depending on the conditions that exist on the uplink channel of the backhaul

communication link.

15   Under control by processor 46, the repeater 12 may consult the predefined

lookup table stored in memory and compare the digital indication of the signal

power level measurement to the predefined ranges to determine the range in which

the digital indication of the signal power level falls. This is shown in step 632B. .

Once the range is determined, the control processor 46 can then extract from the

20   lookup table stored in memory, the corresponding predetermined output power that

the transmitter should transmit at on the backhaul communication link 19. This is

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illustrated in step 633B. Once the predetermined output power level is determined

by processor 46, processor 46 can then send instructions to the backhaul

transceiver to transmit signals over the uplink channel of the backhaul

communication link at the specified power. This is shown in step 633C. Note that

5   the signals transmitted at the specified power on the backhaul communication link

is not necessarily limited to a traffic channel, a control channel, or a combination

thereof. Note also that the processor 46 can optionally include instructions to the

backhaul transceiver to delay transmissions. This is quite useful in a TDMA system

where power control and handover operations are executed at frequency less than

10   frame by frame. Thus, the power control and handover operations will suffer no

impact if the repeater station delays received power level information for a

particular channel by one frame. The delay allows the repeater to deterministically

determine the averaged received power level of burst M as it occurred on frame N.

Then at frame N + 1, the new information of burst M can be translated at precisely

15   one and only one discrete power level amplitude that corresponds to the received

and average power level of burst M on frame N. The entire burst is rebroadcast at

this discrete power level. This delay concept can be extended to non-TDMA

systems by averaging the received signal at the repeater station for some

determined time period and then using the power results of that time period for the

20   next time period.

With reference to FIG. 6, and in accordance with the scope and spirit of the invention, an exemplary lookup table is illustrated. The table described herein is intended for illustrative purposes and therefore, it is not intended to limit the invention in any manner. The following example illustrates how the power level on

5 the backhaul communication link is controlled using the exemplary lookup table. Please note that FIG. 6 provides greater granularity than is really necessary to implement the present invention.

After running the power level measurement algorithm and using the thresholds of FIG. 6, processor 46 gets a digital indication of the power level

10 measurement that is equivalent to -68 dBm. Processor 46 would then access the lookup table stored in memory as a suitable data structure and find the appropriate range within which the measurement falls. For -68 dBm, the range is -66 dBm to - 75 dBm. Once processor 46 locates the appropriate input power range, it would then extract the corresponding predetermined output power level of -70 dBm.

15 Processor 46 can then send an instruction the backhaul transceiver to transmit signals over the uplink channel of the backhaul communication link at a power level of -70 dBm.

In accordance with the spirit and scope of the invention and with reference to the exemplary BTS 15 as illustrated in FIG. 3, steps 640 and 650 of FIG. 4 are

20 now described in detail. A multichannel signal from the backhaul communication link bearing the channel with measured power level from mobile unit 18 can be

received at antennas 68,70 and processed by receiver 56. A wideband receiver 51 processes the multichannel signal and extracts the individual narrowband channels contained in the signal. Each narrowband signal is coupled to one of N respective DSP receiver processing unit 63-1 to 63-2N. Each carrier signal is demodulated

5 and the necessary error correction scheme performed on the demodulated information. Error correction schemes, such as Forward Error Correction (FEC), are well known in the art. For example, U.S. Patent Number 5,896,391 to Solheim et al, titled "Forward Error Correction Assisted Receiver Optimization," describes a FEC methodology. The resulting contents of each channel can then be stored in

10 memory within the DSP 63. The channel containing the power level information would then be stored in the memory associated with DSP's 63-1.

Alternatively, under the control of CPU 64, the contents of each channel can be stored in the shared memory 75 via the common bus 61, thereby giving other peripherals access to the stored information. The CPU 64 can then access the

15 shared memory 75 and manipulate the information for each channel. In this case, the power level indication would be stored in the shared memory 75. Once the channel containing the indication of the measured power level is demodulated and stored in memory, this information may be transferred to the associated memory of DSP 69 for transmission to the managing base station controller (BSC), for

20 example, BSC 17. The BSC 17 would then appropriately instruct the BTS 50 to send a control signal to the mobile unit 18 to decrease power, maintain power,

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boost power, or prepare for handoff to another BTS 15 or possibly to another

repeater 12. Alternatively, as illustrated in step 645 of FIG. 4, the BTS 15 itself

could control the power and allocate channels for the mobile units 18 based on the

discrete power levels received at the BTS 15 from the corresponding repeater 12 in

5   accordance with the present invention.

FIG. 7 is another exemplary lookup table in accordance with the present

invention. Ideally, the mobile transceiver units will have a measured power at the

repeater 12 of approximately -70dBm (corresponding to a predetermined output

level from the repeater station of −80 dBm). In one embodiment of the present

10   invention, the mobile unit 18 is controlled by either the BTS 15 or the BSC 17 to

maintain this ideal mobile uplink power. Of course, it should be understood that

the ideal mobile uplink power could be programmed to be any appropriate level and

-70dBm is provided here for illustrative purposes. After running the power level

measurement algorithm as previously described, processor 46 gets a digital

15   indication of the power level measurement that is equivalent to measured input

power. Based on the measured input power and the predetermined output power

level received at the BTS 15, the BTS 15 or BSC 17 will accordingly instruct the

mobile unit 18 to either lower power, maintain power, boost power, or prepare for

handoff. In this case where the repeater 12 measures -99 dBm, processor 46

20   would then access the lookup table stored in memory as a suitable data structure

and find the appropriate range within which the measurement falls within the range

of -75 to -105 dBM. Once processor 46 locates the appropriate input power range, it would then extract the corresponding predetermined output power level of -90 dBm. Processor 46 can then send an instruction to the backhaul transceiver to transmit signals over the uplink channel of the backhaul communication link to the

5   BTS 15 at a power level of -90 dBm. This would indicate to the BTS 15 or BSC 17 to respond with an instruction to the mobile unit 18 to boost power in order to maintain the ideal mobile uplink power. As FIG. 7 indicates, the BTS 15 preferably receives the backhaul signal at one of four discrete power levels and correspondingly transmits instructions to the mobile unit 18 to decrease power,

10   maintain power, boost power, or prepare for hand off to another BTS 15 or repeater 12.

Although the foregoing invention has been described in some detail by way of illlustration and example for purposes of clarity and understanding, it should be apparent to those of ordinary skill in the art in light of the teaching of this invention

15   that certain changes and modifications may be made thereto without departing from the scope or spirit of the claims.